Chapter 1

Introductory Chapter: The Need for Dietary Interventions for Diabetes

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Additional information is available at the end of the chapter

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1. Introduction

Noncommunicable diseases pose a significant challenge to most of the high-income and low-income countries, with growing numbers of people experiencing the health and economic burden of one or more chronic disease conditions. As such, the incidence of diabetes has been on the rise worldwide. The disease may be associated with the poor quality of life and the risk of developing long-term comorbidities and a higher standard rate of mortality. Health-care professionals are burdened with the task of motivating patients to follow appropriate dietary and exercise guidelines as well as to take insulin injections to improve the regulation of diabetes, and thereby prevent the occurrence of diabetic micro- and macrovascular complications. At present, various interventions are being discussed on an authoritative and regimental level, such as diet, exercise, and even environmental changes.

The more frequently discussed intervention of all is dietary change. Food habits have been shown to be related to the development and management of diabetes—both types 1 and 2, especially through means of influencing glycemic control and insulin resistance. Dietary patterns, rather than individual nutrients, such as the Mediterranean diet, Western diets, and traditional diets, have recently received a great deal of attention in assessing the association between diet and health. In general, to improve glycemic control, a diet rich in fiber and low in saturated fat, sugar, and salt is recommended. Based on considerable medical literature and clinical practice, it has actually been shown that the prognosis of individuals with type 2 diabetes, in particular, is improved with better diet and resulting weight loss. For instance, according to the systematic review by Aguiar et al. [1], it was found that interventions of multicomponent lifestyle involving diet, aerobic exercise, and resistant training were sufficient in inducing modest weight losses and imparting minor improvements in glycemic control, along with the improvements in aerobic fitness and dietary intake.

2. Dietary and behavioral changes

Medical nutrition therapy is an important intervention of diabetes care. This is also of significant when it comes to diabetes self-management, education, and training. When it comes to nutrition, the first priority for individuals requiring insulin therapy is to change their lifestyle so that an insulin regimen is incorporated into their preferred diet and exercise routines.

Despite its importance, there is relatively little evidence on how dietary behavior changes after diagnosis. On average, weight loss after diagnosis is fairly limited. At the same time, there is considerable heterogeneity in this aspect, with some individuals losing more weight and having better clinical outcomes than others. Also, since food products are consumed in combination and nutrients metabolized altogether, it might be more difficult to estimate the associations between individual foods or nutrients and disease incidence compared with the collective approach. Despite these shortcomings of associating diet and diabetes, there have been several aspects, which have been conversed among scientists in relation to prevent the incidence and propagation of the disease.

Lifestyle modifications are an integral part of diabetes management and are generally recommended interventions for most diabetic patients. In fact, it is strongly believed that the treatment of diabetes should start with nonpharmacological therapies such as lifestyle interventions. It is construed as a result of an individual motivation and knowledge, based on personal initiative and responsibility. This focus, however, tends to neglect the relevance of contextual factors. Additionally, for most systematic and scientific studies in this aspect, diabetes duration is an imprecise entity and some individuals participating in such evaluations may have a prolonged period of unrecognized hyperglycemia preceding a diagnosis. For instance, self-management involves complex interactions among people diagnosed with diabetes, involving networks and the broader community [2]. As such, it is recognized that health-promoting initiatives seldom reach those who need them the most.

Out of all diets recommended for diabetes, plant-based diets have received the greatest amount of attention for their use in a variety of diseases such as the management of cancer, cardiovascular disease, obesity, hypertension, and type 2 diabetes mellitus [3, 4]. A plant-based diet is specifically defined as "a regimen that encourages whole, plant-based foods and discourages meats, dairy products and eggs as well as all refined and processed foods" [5]. Inadequate consumption of fruits and vegetables in particular, is estimated to contribute to 5% of excess mortality globally [6]. A recent prospective study in the EPIC cohort indicated that consuming a higher number of different items within the fruit (0–58) and/or vegetable (0–59) food groups was associated with a reduced risk of type 2 diabetes [7]. There are various types of plant-based diets being followed throughout the world, out of which the Mediterranean diet has received much attention recently. This diet is discussed in detail in the next section.

3. The Mediterranean diet as a plausible intervention for preventing the incidence of diabetes

The Mediterranean diet is the most widely discussed and historically significant plant-based diets of all. The Mediterranean diet is a homogeneous and straightforward construct having

its roots in southern European eating patterns. The typical Mediterranean diet, which was first postulated by Ancel Keys in the 1960s [8], is characterized by high intakes of mono-unsaturated fatty acids, vegetables and fruits, plant proteins, whole grains, fish and low-fat dairy products, moderate alcohol (red wine) intake, and low red meat consumption [9]. Following this dietary consumption has demonstrated a reduced risk of mortality associated with mostly neurodegenerative diseases [9, 10]. According to the systematic review by Schwingshackl et al. [9], it was revealed that a significant association between adherence to dietary patterns exhibiting specific Mediterranean diet characteristics and decreased risk of type 2 diabetes. With respect to potential mechanisms of action, there appears to be a causal link between oxidative stress, inflammation, endothelial dysfunction, and diabetes when following this dietary pattern [11]. The Mediterranean diet has also shown a durable effect on circulating levels of C-reactive protein (CRP) and adiponectin in subjects with newly diagnosed type 2 diabetes [12]—an aspect, which is directly related to anti-inflammatory activities.

An observational study aimed to explore a possible relationship between the incidence of gestational diabetes mellitus and the Mediterranean diet pattern of eating was conducted by Karamanos et al. [13]. In this study, in 10 Mediterranean countries, 1076 consecutive pregnant women underwent a 75-g oral glucose tolerance test (OGTT) at 24–32 weeks of gestation, interpreted both by the American Diabetes Association (ADA) 2010 and the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) 2012 criteria. Adherence to a Mediterranean dietary pattern of eating was found to be associated with lower incidence of gestational diabetes and better degree of glucose tolerance, even in women without gestational diabetes.

4. Dietary diversity

Many national and international policies and authorities have recognized the importance of a healthy balanced diet, and numerous dietary guidelines have been issued to emphasize the critical role of the consumption of a diet widely varies to include different types of food products coming from different food groups [6, 14–18]. Although a greater intake of different food subtypes (collectively referred as minor food groups) from each major food group is crucial for nutritional adequacy, indices of diet quality rarely include a measure of dietary diversity and none address variety within food groups other than for fruits and vegetables [19–22].

More recently, analysis in a multiethnic cohort concluded that a higher number of different food items (between 0 and 120) consumed at least twice a week was not associated with incident type 2 diabetes [23]. It is possible that a diet comprising of all five major food groups could still depend on the consumption of a comparatively slender range of foods within each group [19]. In this sense, it would be best if a higher overall diversity is maintained at the major food group consumption level, but with less variation in terms of different subtypes of foods. It is suggested in the review by Conklin et al. [19], that despite common advice recommended to consume a varied diet [6, 15, 18], it was not obvious whether studies have investigated how the number of different food groups and different subtypes within each food group included in a diet are associated with the risk of contracting diabetes. Nevertheless, the findings by Conklin et al. [19] supported many of the current public health recommendations, which encourage the consumption of all major food groups and also other different types of

fruits, vegetables, and dairy products as part of a regular balanced diet. However, it has to be borne in mind that the additional costs of greater diversity require a comprehensive food pricing strategy as well [19].

5. The Paleolithic diet

The Paleolithic diet is another regimen, which has been recently discussed as a means of obtaining weight loss and control of glycemic levels. This diet, in particular, has been shown to be more satiating per calorie compared to the diabetes diet [24, 25].

General information provided on the diabetes diet aims at providing meals with even distributions of increased portions of vegetables, root vegetables, dietary fiber, wholegrain bread, and other whole grain cereal products, fruits and berries, and less total fat—in particular, unsaturated fats [25]. The salt intake was recommended to be kept below 6 g/day [26]. In this respect, the Paleolithic diet was described to be based on lean meat, fish, fruit, leafy and cruciferous vegetables, root vegetables, eggs and nuts, with reduced intakes of dairy products, cereal grains, beans, refined fats, sugar, candy, soft drinks, beer, and added salt [26]. The following items were recommended in limited amounts for the Paleolithic diet: eggs (≤2 per day), nuts (preferentially walnuts), dried fruit, potatoes (≤1 medium-sized per day), rapeseed or olive oil (≤1 tablespoon per day), and wine (≤1 glass per day) [26, 27]. The recommended intake of the other types of food products did not carry any restrictions and no advice was given with regard to the proportions of food categories [26, 27]. The evolutionary preference and rationale for the Paleolithic diet has been highlighted in Eaton et al. [27].

The Paleolithic diet is known to result in significantly lower fasting plasma leptin, nonsignificantly lower fasting plasma glucagon concentrations as well as gain weight loss, compared with a standard diabetes diet [28–30]. However, the small sample size in studies such as those by Eaton et al. [27] makes it impossible to perform adjusted multivariate analysis. Overall, long-term and adequately powered trials investigating the effects of Paleolithic diet are warranted.

6. Diet and the microbiota

The importance of microbiota in the incidence of diabetes has been a recently discussed development. The gut microbiota has been hypothesized to be a link between environmental factors and the development of autoimmunity and diabetes [31]. The first gut microbiota composition is mostly acquired at birth, while the delivery mode determines the type of microorganisms that will colonize the newborn gut. After delivery, the diet is one of the main factors affecting the composition of infant gut microbiota. The diet provides substrates and sources of bacterial contamination from breast and nipple skin to breastfed babies [31]. Diet also contributes indirectly toward the regulation of intestinal and pancreatic health.

In several studies, it was found that the age, dietary patterns, geography, traditions, and culture were the main determinants explaining the differences in gut microbiota composition

[31–33]. The modulation of the immune system by the gut microbiota essentially begins even before birth. It is obvious that the intrauterine environment of the fetus during pregnancy is not completely sterile. There is evidence that the placenta of a term pregnancy has many nonpathogenic commensal microbiota in low-abundance, similar to the oral microbiome of nonpregnant women [31]. Following birth, diet, and microbiota are the decisive factors that guide the proper maturation of the immune system [32].

Dietary antigens, especially those associated with type 1 diabetes, depend on early feeding regimens, the age of introduction of foods, especially wheat, to the infant's diet, and the current consumption of nutrients [34, 35]. Understanding and hypothesizing that the gut microbiota is an organ will make it possible to integrate its relationship with diabetes as a key for designing new therapies to prevent and/or improve the control and propagation of the disease. Dietary components provide different substrates, which may ultimately result in several products during the fermentation processes. Changes in the structure of the microbiota due to dietary modifications are because some of the bacterial communities are "genetically better equipped" to metabolize those substrates [31].

7. Conclusions

A multicomponent-based lifestyle enabling the prevention of diabetes, which includes diet and both aerobic and resistance exercise training, is generally regarded as the most effective in inducing weight loss and improving impaired fasting glucose, glucose tolerance, dietary, and exercise outcomes in at-risk and prediabetic adult populations. Several scientific studies support the current dietary and exercise guidelines for the inclusion of resistance training in type 2 diabetes prevention. However, when it comes to exercise and other physical workouts, there remains an urgent need for more rigorous studies, with long-term follow-up evaluating program efficacy, muscular fitness outcomes, diabetes incidence, and risk reduction.

Overall, a low-carbohydrate diet score has been significantly associated with a decreased risk of diabetes. This association is attenuated through adjustment of the glycemic load. The composition of the gut microbiota is also believed to be related to diabetes prevention especially since it can be modulated by diet. This modulation can promote the proper maturation of the immune system or result in gut dysbiosis and aberrant immune responses, which can eventually lead to autoimmunity and diabetes, especially in children.

People who live their lives with their diabetes are interconnected with their multilevel network and it has been observed that they adapt the illness to their life, not the opposite. In terms of the psychology of being contracted with this disease, to meet a sustainable network approach, thus involves wide encounters encompassing life factors at different levels. All social, political, and cultural factors are influential and interwoven in the dynamics, negotiations, and tensions of everyday life for people with diabetes. The impact of network on self-management of diabetes needs to be recognized and emphasized in clinical practice, as well as in the education of healthcare professionals, in research as well as in health policy to understand and respond to provide support and advice to the diabetic patients.

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